

# ANALYSIS OF POLICY EFFECTIVENESS ON FOREST FIRES IN RIAU, INDONESIA

by

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## EXECUTIVE SUMMARY

This report analyzes how effective Indonesia's forest fire policy is in Riau province, how it is being implemented, and ultimately recommends ways to improve the policy. A recent forest fires policy in Indonesia was established in 2007 as a comprehensive plan of action to deal with land and forest fires. It is basically a package plan containing various measures for each of six elements: monitoring, prevention, fire suppression, dissemination of information, law and regulation, and international cooperation.

This project draws attention to the fact that forest fires are a common phenomenon in Indonesia, happening almost annually in the western part of the country. Fires are deliberately set as a means of clearing land. However, large fire events have been aggravated in times when weather patterns favor prolonged drought caused by the El Nino Southern Oscillation (ENSO). Riau is one of the provinces in Indonesia that experiences this regularly; one of the recent series of fires occurred in January-March 2014.

I compared the *status quo* of existing socio-economic damage from the 2014 fire and related it to a counterfactual scenario of how different the damages would have been without the policy, so that I could infer the effectiveness of the policy. My methodology involved conducting interviews with 14 forest fire experts in the country (from the national government, provincial government, and NGOs), as well as literature reviews.

The set of interviews I conducted suggested that some elements of the plan of action might have had some influence on limiting the severity of damage and losses from the 2014 fire. The experts in general were convinced that the 2014 forest fire would have burnt 10 - 60 % more area, and that the overall damage and losses would have been worse had the policy not been enacted. The evaluation of expenditure and benefit also suggests that the benefit most likely outweighed the cost of implementing the policy by up to 20 times. A number of shortcomings of the policy were also addressed.

This report makes several key points and recommendations:

- The budget for policy implementation is insufficient and needs to be increased
- The government should invest more in zero burning land clearing equipment and spend less on fire suppression.
- There needs to be a special agency overseeing policy implementation with the authority above all of the ministries and agencies involved in the policy.
- Information on the plan of action should be made widely available to different parties to enable better policy assessment.

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## **I. INTRODUCTION**

### **Land and Forest Fires in Indonesia**

Indonesia has the third largest forested area in the world, after Brazil and the Republic of Congo (Aiken, 2004). Moreover, Indonesia's peatland area is the fourth largest in the world with a total of 20 million hectares (Mubekti, 2011). Although the country is blessed with abundant forest resources and biodiversity, it has a long history of peatland and forest fires. Studies have shown fires have been a regular feature of the country's landscape for as long as the area was inhabited (Barber & Schweithelm, 2000). Sediment and charcoal analysis indicate that forests have burned periodically throughout the past 17,000 years (Glover & Jessup, 1999). Inhabitants have done this mostly to facilitate hunting activities and clearing land plots for shifting agriculture practices (Glover & Jessup, 1999).

Better historic records on forest fires in Indonesia and some other Southeast Asian countries go back to the 17<sup>th</sup> century, when fires started to break out in Borneo and parts of Thailand (Aiken, 2004; Herawati & Santoso, 2011; Nguitragool, 2011). Large fire events seem to happen more frequently now, particularly since the 1980s (Herawati & Santoso, 2011; D. Taylor, Saksena, & Kucera, 1999). These fires occur almost every dry season and when the El Niño Southern Oscillation (ENSO) created anomalous weather patterns which prolonged drought (Jim, 1999; Gaveau et al, 2014). El Niño is a term to describe the variation of the sea surface temperature, which leads to a global change in temperature and precipitation (Herring, 2009; Pidwirny, 2006). Fires are more extensive on the islands of Sumatra and Kalimantan, usually during the dry season between March and September (Gellert, 1998).

Most of these massive fires occur when climate conditions and meteorological parameters are favorable. Studies have revealed how the weather anomaly of El Niño plays an important role in aggravating the risk of forest fires in Indonesia. El Niño events coincides with many of the years when Indonesia's most massive fires occur, and El Niño is believed to aggregate the severity of the fire (Field, Werf, & Shen, 2009; Langner & Siegert, 2008; Wooster, Perry, & Zoumas, 2012). El Niño used to occur every 2-7 years, with varied magnitudes and lengths of occurrence (Herring, 2009; Pidwirny, 2006). However, in more recent decades, its occurrence has become more frequent and less predictable, which some believe to be influenced by global warming (Field et al., 2009; Haberle, Hope, & Kaar, 2001; David Taylor, 2009). The event causes increased temperatures in Indonesia, which lead to prolonged drought during dry seasons throughout the country, making land and forest more susceptible to fire. According to Langner and Siegert (2008), areas impacted by fire during droughts induced by severe El Niño events were triple that of typical weather conditions. The study also confirmed that the most serious impacts were experienced in peat forest ecosystems. Some of Indonesia's most severe forest fire events happened

during extreme El Niños in 1982-1983, 1994, 1997-1998, and 2006 (Glover & Jessup, 1999; Langner & Siegert, 2008; David Taylor, 2009), although in other years, lower intensity, less widespread fires still occurred almost annually in Indonesia during weaker El Niño phenomena (Field et al., 2009; Wooster et al., 2012).

El Niño, however, is not the only cause of land and forest fires in Indonesia. Forest fire incidents depend not only on how dry it is and the amount of potential fuel in the forest, but also on the likelihood that fuel will ignite, which in Indonesia is related mostly to human activity (Glover & Jessup, 1999). Fires have long been deliberately set by humans as a means of land-clearing for agriculture purposes (Aiken, 2004; Gellert, 1998; Vayda, 2006). Fire is the cheapest and fastest tool for land clearing and has been practiced widely in Southeast Asia and in the rest of the world for hundreds of years (Tan, 1999). The early slash-and-burn farmers relied heavily on the use of fire to practice shifting cultivation for 5,000 years (Haberle et al., 2001; Tan, 1999; David Taylor, 2009). These farmers would burn plots of lands before utilizing them, and finally leave them to move to other areas to resume farming. According to a high level official at Indonesia's National Disaster Management Agency (BNPB), burning would only cost around 200,000 to 300,000 rupiah (around US\$ 20 to 30) per hectare, while modern equipment may cost 4 to 5 million rupiah (around US\$ 400 to 500) per hectare (BNPB, 2014).

However, the trend in slash-and-burn agriculture has shifted from creating small plots and leaving them for long intervals to creating larger plots for longer intervals, which is caused mostly for the creating of plantations for agriculture products (Barber & Schweithelm, 2000; Glover & Jessup, 1999). This arrangement does not give sufficient time for the vegetation to recover between rotations, hence land and forest are becoming degraded and are more prone to fire (Barber & Schweithelm, 2000; Glover & Jessup, 1999). The more recent human-induced fires in Indonesia may be linked to the government's goal during the Suharto regime in the 1980s to increase economic growth by becoming the largest exporter of wood pulp in the world (Jim, 1999). At that time, Indonesia began a period of rapid development and commenced a large expansion of plantations for palm oil and timber to promote economic growth (Gellert, 1998). To accomplish this vision, the highly centralized government took complete control over national forests, which account for 75% of the country's land (Aiken, 2004). The national government assigned the Ministry of Forestry to manage land concessions and to designate areas for commercial purposes (Gellert, 1998). Deliberately setting fires for clearing land, combined with extreme drought, consequently resulted in uncontrollable fires and spreading massive haze from the carbon that was released (Glover & Jessup, 1999).

However, large, destructive, and uncontrollable fire events are not desirable in any country, because the domestic and trans-boundary effects cause immense damage and liability. In 1982 for example, fires burned 3.5 million hectares in East Kalimantan alone, damaging 70 percent of commercial-size trees with a loss of standing timber and growing stock valued at more than US\$ 5 billion (Gellert, 1998; Malingreau, Stephens, & Fellows, 1985). The fire went out of control and continued for three months, caused thick smoke to spread to Malaysia and Singapore. The media reported that flights in the Singapore airport had to be rescheduled or re-routed to avoid the haze for quite some time, and that boats were not able to dock at ports (Lamb, 1984).

Unfortunately, poor national records and lack of data make it difficult to gather comprehensive documentation on every fire event in Indonesia. Little information was available on the monetary value of damage and the losses created by previous fires, until one of the most devastating forest fire events in Indonesia occurred in 1997-1998. The period was one of the warmest years caused by El Niño, known as 'the year the world caught fire' (Glover & Jessup, 1999). Many publications reported how the Southeast Asia region had probably never seen extreme fire like what happened in 1997-1998, hence, this environmental disaster alarmed scientists and officials to investigate the causes and costs of the massive fire in the country (Vishvanathan, 1997). Since then, global attention has increased on these fires, especially because they pose a serious threat to the ecosystem and to human health.

Indonesian citizens suffered major economic losses and social damage during the 1997-1998 fire. The fire burned 9.7 million hectares of forests (BAPPENAS & ADB, 1999), which caused immediate damage to agricultural crops and plantations, farmlands, peat forests, as well as protected areas and primary forests in Sumatra and Kalimantan (Barber & Schweithelm, 2000; Jim, 1999; Tacconi, 2003). The loss of forest products, which included timber and non-timber products, harmed the forest products industry specifically, and impacted the regional economy as a whole (Tacconi, 2003). Due to the ecological damage, ecosystem functions and habitats were also destroyed, which caused a loss of tropical flora and many endangered species such as Orangutans (*Pongo pygmaeus*) and Sumatran Tigers (*Panthera tigris sumatrae*) (Jim, 1999; WWF & EEPSEA, 2003). According to WWF and EEPSEA, fire-related damages on timber, agriculture, direct and indirect forest benefits, and biodiversity resulted in a loss of about US\$ 2.8 billion (2003).

In addition, haze-related damages to human health and the environment were also immense. The massive fire emitted a great amount of carbon dioxide (CO<sub>2</sub>), creating a thick haze that spread to neighboring countries (Jim, 1999; Vayda, 2006; Vishvanathan, 1997; WWF & EEPSEA, 2003). Page et al



(2002) estimated that the 1997 fire emitted 13 to 40 % of the annual global fossil fuel emissions, which was a huge contribution to global warming that year.

This fire event also had a significant impact on human health. As air pollution increased to hazardous levels, smoke increased respiratory and eye problems for people, and even increased premature deaths to vulnerable groups (Cotton, 1999; Glover & Jessup, 1999; Jim, 1999; Tan, 1999). Almost US\$ 1 billion was spent for short-term health treatment; an additional expenditure on long-term health effects was probably large, but difficult to quantify (Glover & Jessup, 1999; WWF & EEPSEA, 2003). In the more recent fire events, air pollution exceeded the hazardous level and increased risks of respiratory problems (Aiken, 2004; Frankenberg, McKee, & Thomas, 2005).

In addition, the haze created poor visibility, which disrupted transportation. The airlines industry lost a great deal of profit as flights were cancelled for weeks in Indonesia, Singapore, and Malaysia with a total value of US\$ 25 million for the three countries, and tourism activities decreased significantly, with the three countries suffering from tourism-related losses of up to US\$ 257 million (WWF & EEPSEA, 2003). Business and school activities were also halted to avoid exposure to high levels of pollution. Businesses suffered from forgone profits caused by lost workdays due to the temporary shut-down of operations (Barber & Schweithelm, 2000).

Studies have revealed some alarming numbers on the total economic loss from this environmental disaster of 1997-1998. Indonesia's Environment Ministry's environmental emergency project estimated losses from the 1997 fire event alone amounted to US\$ 2.4 billion, while WWF and EEPSEA estimated total cost of US\$ 4.5 billion (Barber & Schweithelm, 2000; WWF & EEPSEA, 2003). BAPPENAS and ADB estimated a total cost of US\$ 9.3 billion for the entire 1997-1998 fire, whereas the WRI estimated losses at US\$ 8-10 billion (BAPPENAS & ADB, 1999; Barber & Schweithelm, 2000). Unfortunately, comprehensive studies on fires after 1997-1998 in Indonesia is yet to be present.

### Land and Forest Fires in Riau

One of the provinces experiencing regular fires in Indonesia is Riau. The province is located in the eastern part of Sumatra, one of Indonesia's five largest islands. The administration of Riau is divided into ten districts (*kabupaten*): Bengkalis, Indragiri Hilir, Indragiri Hulu, Kampar, Kuantan Singingi, Pelalawan, Rokan Hilir, Rokan Hulu, Siak, and Meranti, and the two municipals (*kota*) of Dumai and Pekanbaru. The province has a population of 6.1 million people, concentrated in the provincial capital Pekanbaru (BPS-Riau, 2013).



**Figure 1. Map of Indonesia & Riau**

*Source: Indonesia National Forest Monitoring, Ministry of Forestry*

Riau is one of Indonesia's richest provinces, generating substantially more forest products compared to other provinces (BPS, 2011b; Mubyarto, 1997). Since the Suharto regime in the 1980s, the province has been a target of forest product expansion, including rubber, pulpwood, and palm oil (Mubyarto, 1997). In recent years, Sumatra, particularly Riau, has become the center for large-scale plantations of palm oil and timber (Lee et al., 2013; Yulianti, Hayasaka, & Sepriando, 2013), which has contributed to Indonesia being the world's largest palm oil producer and the world's biggest crude palm oil exporter, surpassing Malaysia (World Bank, 2011, 2014). Now, Riau's GDP is among the top four provinces contributing to the nation's total GDP (World Bank, 2014), most of which originates from the agriculture and forestry sectors (BPS, 2011a).

Consequently, the continued expansion of oil palm and exploitation of forest resources have resulted in Riau becoming one of the provinces with the highest deforestation rates in the country (Lee et al, 2013). Lee et al. (2013) reported a loss of 70 % of peatland areas and 52 % of lowland forest during 2000 - 2010. The same study correlated these losses with the intensive annual fire events from 2000-2012.

About 50 % of Riau's 8.7 million hectare forests is peatland (Kemendagri, 2013; Mubekti, 2011). The majority of these peatlands fall into the category of 'deep' and 'very deep', often more than 2 meters

in depth (Mubekti, 2011). Peatlands are ‘wetlands with a thick water-logged carbon-rich soil layer’ (Wetlands International, 2014). Due to its high carbon density, peatland becomes highly flammable during dry seasons, and once fire has started they can be very difficult to extinguish (Nguitragool, 2011; Usup, Hashimoto, Takahashi, & Hayasaka, 2004). Furthermore, a senior official from the Ministry of Forestry stated that extinguishing these peatland fires would be impossible without aerial suppression support and weather modification methods.<sup>1</sup>

Among Indonesia’s 33 provinces, Riau has had the highest hotspot count every year for the past decade, including 2014 (Sizer, Leach, et al., 2014). Hotspot is a term used to describe a location that releases high-temperatures (radiation) captured by a thermal detector from satellites and sent to a receiving station (Freiburg, 2000; NASA, 2000). Different satellites have different specific threshold values in Kelvin to determine whether the average surface temperature can be translated into a fire occurrence, along with other indicators of confidence. Therefore, hotspot images do not always appear to be firespots, depending on the interpretation and ground verification. The Indonesian government uses two types of sources: (1) NOAA-18<sup>2</sup> (National Oceanic and Atmospheric Administration) satellite program and (2) MODIS sensors on the Aqua and Terra satellites<sup>3</sup>.

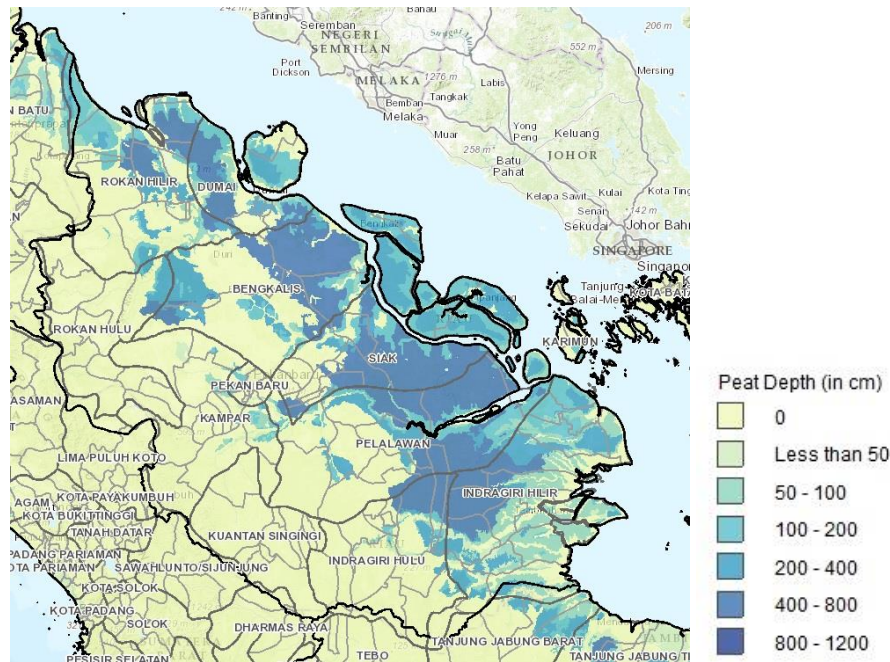
More than 50 % of Indonesia’s hotspots in 2014 were located in Riau, especially in the coastal peatland (Sizer, Leach, et al., 2014; World Bank, 2014). This is corroborated by Yulianti et al (2013), who claimed that most of the fire prone areas with more than 100 hotspot counts each year were found along the coastline of the eastern part of Sumatra, especially in Riau. The western part of Riau is largely composed of lands without peat, while the eastern part of the province along the coast line is covered by a significant amount of relatively deep peatlands of more than 400 cm (the darker blue color). Consequently, the government included the province as one of the most fire-prone areas in the plan of action dealing with land and forest fires.

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<sup>1</sup> Interviewed December 2014.

<sup>2</sup> Gary Davis. History of the NOAA Satellite Program, <http://www.osd.noaa.gov/download/JRS012504-GD.pdf>.

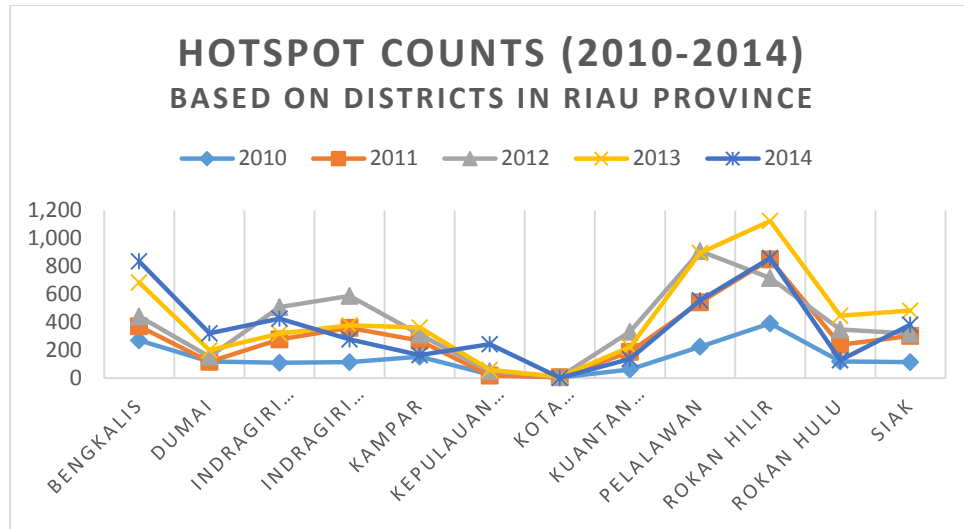
<sup>3</sup> About MODIS (Moderate Resolution Imaging Spectroradiometer), <http://modis.gsfc.nasa.gov/about/>.



**Figure 2. Peatland distribution map in Riau.**  
**Most of the deeper peatlands are located along the eastern part of the province.**  
*Source: Fires Global Forest Watch – Peatlands land cover for Indonesia*

## II. JANUARY-MARCH 2014 LAND AND FOREST FIRES

After forest fires occurred in Riau in mid-June 2013, the province experienced another fire in early 2014. According to the NOAA-18 satellite, most of the hotspots that were detected originated from Riau (2,259 hotspots) between January and March 25<sup>th</sup>, 2014, followed by West Kalimantan (1,059 hotspots), and North Sumatra (499 hotspots) (BNPB, 2014). BNPB's report stated that satellite imaging from NOAA 18 recorded the peak number of hotspots at 2,208 and 1,398 in February and March 2014, respectively. However, reports on hotspots in Riau seem to vary among different institutions, because the Ministry of Forestry recorded 2,621 hotspots for the same period of time and WRI recorded 2,739 hotspots, possibly due to different satellite imagery that was used to analyze them.

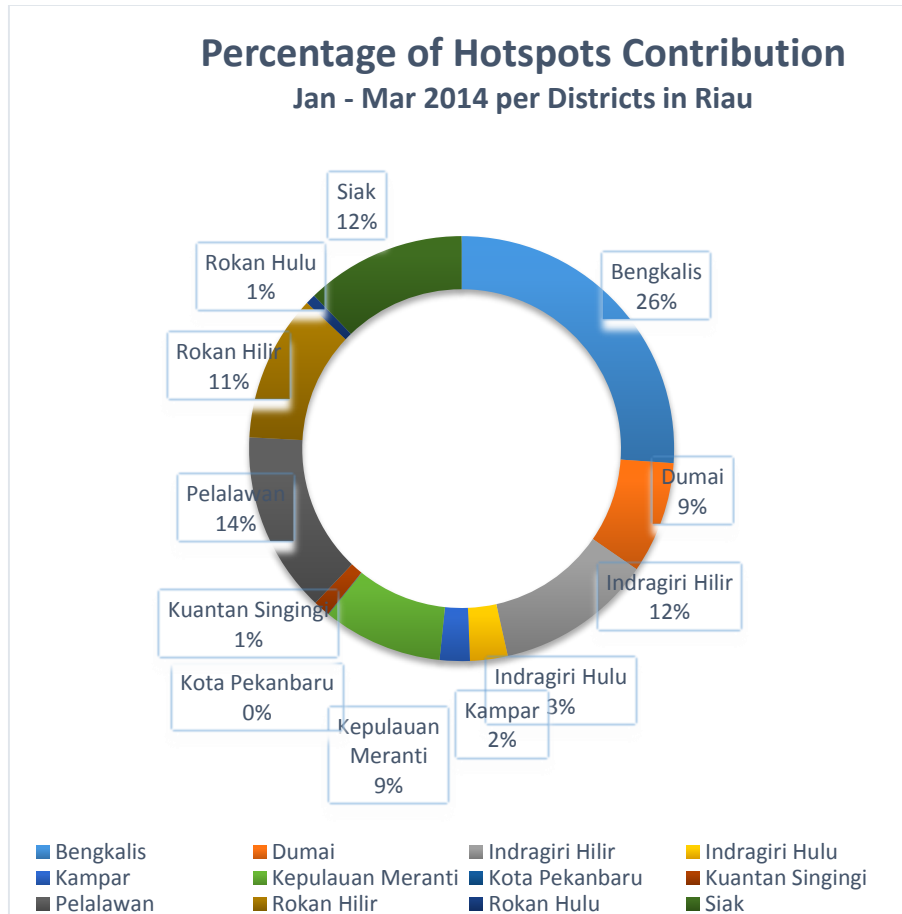


\*: 2014 hotspot counts were for the whole year (January to December).

**Figure 3. Hotspot counts in Riau province 2010-2014 based on districts.**

*Source: Ministry of Forestry and Riau's Natural Resource Conservation Agency database (2014)*

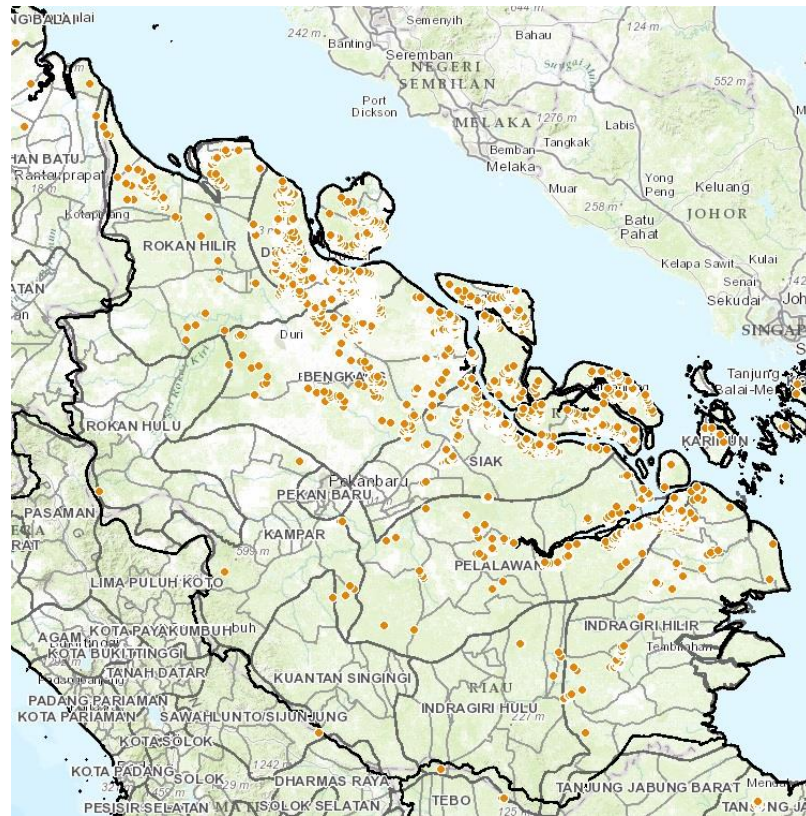
In the early 2014 fires, the highest hotspot counts in Riau occurred in six districts: Bengkalis (26%), Pelalawan (14%), Siak (12%), Indragiri Hilir (12%), Rokan Hilir (11%), and Kepulauan Meranti (9%). These districts combined account for 84 % of the total hotspots in Riau. In terms of area, these six districts together comprise about 65 % of the total Riau area. This means that a huge percentage of almost all hotspots in early 2014 were located across a substantial area of Riau.



**Figure 4. Distribution of Hotspots in Riau's Districts (January-March 2014)**  
*Source: Ministry of Forestry, 2014*

To obtain information on occurrences of fires in Riau during the event, I retrieved data from the Global Forest Watch Fires website, using archives of NASA active fires with only high confidence data on fires from January to March 2014. The distribution of hotspots seemed to be concentrated along the high peatland areas or coastline in the eastern area (**Figure 5**), confirming some claims that 75 % of the hotspots occurred in peatland (Qodriyatun, 2014). A number of hotspots were also seen scattered in the mid-part of the province. Moreover, based on WRI's study, most of the fires occurred in plantation areas (Sizer, Anderson, et al., 2014; Sizer, Leach, et al., 2014).





**Figure 5. Distribution map of firespots in Riau (1 Jan - 31 March 2014). Fires are mostly concentrated in the eastern districts near the coastline.**

*Source: Global Forest Watch Fires using archive of NASA active fires for Indonesia with only high confidence fires*

According to BNPB, fire suppression efforts for this particular fire had absorbed more than half of its anticipated disaster relief fund for forest fires in 2014, amounting to 167 billion rupiah (around US\$ 17 million) (2014). These funds were mainly used to rent Russia's aircraft for aerial suppression operations, including weather modification and artificial rain, as well as fuels and other logistic needs for fire brigades.

The magnitude of impacts of the 2014 fire was substantial. Due to the poor visibility and hazardous air pollution index for days, schools and businesses were shut down for several weeks, airlines could not operate, around 58,000 individuals were estimated to suffer from acute respiratory infections, and losses from economic activity was estimated to shrink Riau's GDP by almost 3 % (WRI, 2014). The head of BNPB stated that losses amounted to 15 trillion rupiah (BNPB, 2014).

The World Bank (2014) incorporated a study on Riau's land and forest fire event in its July 2014 Indonesia Economic Quarterly, in which it estimated total damage and loss of US\$ 935 million (around 10.3 trillion Rupiah). The World Bank's study revealed that approximately 176,000 hectares was burned during the event; some 68,500 hectares were in industrial forests and 30,000 hectares were in palm oil

plantations. The World Bank quantified damages from ten sectors to develop these estimates. Forestry, agriculture, and manufacturing came at the top of the list, followed by trade, transportation, tourism, mining, health, humanitarian expenses and fire-fighting costs, and environment.

### **III. RECENT POLICY CHANGES IN LAND AND FOREST FIRES**

Forest fire policies and land management have evolved considerably since the massive fire in 1997/1998. The Government established *Indonesia's Comprehensive Plan of Action (PoA) in Dealing with Forest Fires* in 2007. The Plan of Action is a compilation of different policy elements with the objective to control fires and hotspots. It consists of a list of diverse measures from prevention efforts to suppression operation.

The *Comprehensive Plan of Action in Dealing with Forest Fires* has become the 'umbrella policy' involving a collaboration between the national and provincial government to integrate efforts to deal with the issue (Litta, 2012). The plan of action brought together more than fifteen ministries, agencies, and high-ranking officials to address the issue according to their respective area and mandate. This is officially acknowledged in the Presidential Instruction 16/2011 on land and forest fires control.

The plan of action was initiated right after the ASEAN (Association of Southeast Asian Nation) ministerial meeting in 2006. The ten member states of ASEAN, including Indonesia, have been conducting regular meetings twice a year since the massive fire in 1997/1998. The meetings are called 'technical working group and ministerial steering committee on transboundary haze pollution', held by high-ranking officials and environment ministers. The objectives of these meetings are to ensure that haze and fire outlooks are shared among countries as well as providing a venue for policy discussions and cooperation related to forest fires. Delegates from each country share information on the latest weather parameters, forecasts of meteorological conditions, as well as updates on fire and haze occurrences in their respective countries. Since the establishment of the plan of action, the meeting set a special agenda for Indonesia to inform the implementation of its plan of action.

The formulation of Plan of Action was started by identifying 35 fire-prone districts in 8 provinces across the country. By identifying these areas, attention is concentrated on districts where fire is very



likely to occur yearly. The objective of the plan of action was to reduce hotspots by at least 20 % each year, based on the 2006 hotspot counts (Department of Environment of Malaysia, 2010)<sup>4</sup>.

In general, the plan of action includes improving related laws and regulations, projects on improving sustainable land management, campaigns for zero burning practices, public awareness enhancement programs, improving emergency response tactics, human resources, and institutional capacities programs. It also provides a venue for coordination from different levels of government ministries and agencies. The policy has six elements: (1) monitoring, (2) prevention, (3) fire suppression, (4) education and public awareness, (5) law and regulation, and (6) international cooperation. Based on information from different government websites, interviews I conducted with government officials, and experience in forest fire-related issues, the following explains Indonesia's plan of action.

In **monitoring**, the Indonesian Government develops its haze trajectory forecast using the 3 days forecasting model. They also develop fire-prone area maps. Even though the national government has been familiar with the FDRS (Fire Danger Rating System) technology for quite some time, they now make it available to the public through BMKG's website, and they are determined to improve its predictive ability to 7 days in advance. FDRS is a system to analyze weather parameters and relate it to the potential of how easily fires can occur and how difficult it would be to extinguish them. Immediate on-site evaluations, patrols, and ground checks after hotspots were detected from the satellite were also mandatory at the local government level, which is now cooperating with companies and local NGOs. Hotspots counts are being closely monitored from NOAA 18 and MODIS satellites, with a real time update shared within the *Indofire System*<sup>5</sup>. This system was effectively launched in 2009 as a joint project among the Ministry of Forestry, the Ministry of Environment, LAPAN, and the Government of Australia, to detect and monitor land and forest fires; this serves as an early warning system for immediate response. Information on hotspots, weather anomalies, and related information is being shared through the hotspot monitoring mailing list (*SiPongi*), which is comprised of different government institutions throughout the country, companies, NGOs, community groups, and other stakeholders.

In **preventive** efforts, updated information of hotspot counts is distributed to all stakeholders, including number of hotspots, future trends, areas where hotspots are detected, location of detected hotspots based on spatial use and type of land, total cumulative number of hotspots compared to target

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<sup>4</sup> Haze Action Online. 2006. *Indonesia-Singapore Collaboration*. [http://haze.asean.org/?page\\_id=234](http://haze.asean.org/?page_id=234); APEC-EGS. 2009. *ASEAN Ministerial Meetings on Transboundary Haze Pollution*. <http://eqs.apec.org/more-articles/159-asean-ministerial-meetings-on-transboundary-haze-pollution>.

<sup>5</sup> Indofire. *Indofire Map Service*. <http://indofire.landgate.wa.gov.au/> and <http://www.indofire.org/>

of hotspots reduction. The government also establishes and activates fire control command bases and builds firebreaks in fire-prone areas. The number of operation bases (DAOPS) has been increased to 33 across fire-prone provinces where *Manggala Agni* is fully vigilant. *Manggala Agni* is the forest fire control brigade unit under the Directorate General for Forest Protection and Nature Conservation, the Ministry of Forestry. Investments in technological aspects for fire detection and control have also been made. The national government provides local governments and communities with portable pumps and facilitate canal blocking in peatland areas. They also develop provincial level fire-prevention implementation models and projects on sustainable peatland management.

The policy in **fire suppression** has also evolved and become more comprehensive and coordinated. The rapid response brigade under BNPB was launched in 2009 by the Coordinating Ministry of People's Welfare. It was established for disaster emergency response in Indonesia (including forest and land fires) to include management, technical, and logistic support for disaster relief. The brigade consists of members from various institutions - including armed forces, police, SAR, Indonesia Red Cross, and additional *Manggala Agni Tactical Response* (satuan manggala agni reaksi taktis/SMART). As of April 2012, *Manggala Agni* has more than 1,243 personnel and SMART has 437. Through experience, the Indonesian Government realized that merely implementing ground fire-suppression efforts would be difficult and insufficient to put out fires immediately. Aerial efforts, therefore, have always operated fully through weather modification technology (artificial rain operations) and water bombing.

**Dissemination of information** through public awareness zero-burning campaigns and human resource capacity building has also been conducted continuously since the policy took effect. This aspect is basically being done for three large groups. In the first group (local communities), the policy launched programs and projects involving seminars to encourage communities not to use fire for land clearing. For community empowerment, the community fire brigade was established and professionally trained (*Masyarakat Peduli Api*), and now has almost 9,000 members. Campaigns on zero burning practices to local farmers and the community are complemented with training on how to make compost, charcoal, and briquettes out of raw materials from land clearing waste. In the second group (provincial and local government) capacity development for the *Manggala Agni rapid response* personnel and for local governments on monitoring hotspots in fire-prone districts are held, assisted by the national government. For the third group (companies), the policy mandates the development of fire control brigades in concession areas, zero burning campaigns, and laws on plantation, environment, and forestry.

The plan of action has also become grounds for improvement in **law and regulation**. The first is Law (*Undang Undang*) Number 32/2009 on environmental protection and management. *Undang Undang*

is the highest type of law in Indonesia's hierarchy of laws after the Constitution. The law highlights issues related to preserving the environment, mitigating environmental pollution, utilizing natural resources wisely, and promoting sustainable development. This law also prohibits burning and enforces zero burning policy for land clearing. When the policy was established in 2007, the government started to formulate a new regulation that directly addressed land and forest fire control. The Presidential Instruction (*Inpres*) Number 16/2011 on the improvement of land and forest fire control was then officially enforced. Now it is the most updated regulation in the hope of enhancing fire control efforts. The focus of this regulation is to give a strong mandate to all related governmental institutions to improve and coordinate with each other in prevention, suppression, and post-disaster operations. The regulation also instructs agencies on how to improve community involvement and law enforcement.

Under the plan of action, Indonesia conducted a number of actions of **international cooperation** under a special MoU (memorandum of understanding) through bilateral agreements or through the framework of ASEAN. Different projects have been conducted across the 8 fire-prone provinces. In Riau, among others, there is the Indonesia-Malaysia Collaboration in Rokan Hilir to prevent land and forest fires and the Indonesia-Japan effort in Siak to enhance community capacity on fire control. These projects involve training on zero burning techniques and capacity building for farmers, building canal blocks and water storage wells, rehabilitation of degraded peatlands, and firefighting training.

#### **IV. RESEARCH OBJECTIVES**

The combination of natural and anthropogenic causes of forest fires, as well as the massive destruction it causes, have made forest fires a multifaceted issue extensively studied in the past, encompassing causes, impacts, and possible solutions. While there has been ample literature on forest fires in Indonesia, studies were focused specifically on the 1997/1998 episode and very few studies have analyzed how the policy influenced this more recent forest fire.

Numerous studies have reported how Indonesia is lacking measures and efforts related to forest fires (Aiken, 2004; Barber & Schweithelm, 2000; Cotton, 1999; Gellert, 1998; Jim, 1999; Vishvanathan, 1997), while others mention that the enacted regulations have failed to reduce, eliminate, or address the root causes of fires and, thus, fires keep occurring (Greenpeace, 2014; Herawati & Santoso, 2011). Numerous articles and media, both national and international, have also mentioned how policies were unable to stop the annual fires. Because previous research devoted less attention on how influential recent policies are, it remains unclear what difference this policy makes on recent forest fire events.

However, measuring policy effectiveness merely by assessing whether fire happened or not every year would not be an appropriate approach. Viewing the problem from the two ends of the spectrum, whether fire occurs or fire does not occur at all, would contribute little to understanding the process needed to reach the ultimate goal of eliminating land and forest fires in Riau. Therefore, this study offers a way to look at how the policy is effective, not merely by judging one single parameter (the occurrence of fire), but rather by looking to what extent damage was avoided by implementing the policy.

The primary purpose of the study is to analyze how effective the policy on forest fire is by estimating what the 2014 fire damages would have been without the policy. I am interested in understanding whether government intervention (policies) influenced the outcome (damage and losses) of the forest fire in early 2014 in Riau. By comparing the *status quo* of existing socio-economic damages and relating them to a counterfactual scenario of what the damages would have been without the policies, we can infer the effectiveness of the policies.

Specific questions to be investigation by this project are the following:

1. How did the policy process unfold?

By interviewing experts, I aim to extract qualitative data to get a sense of how the policy process evolves.

2. How would the 2014 forest fires in Riau Province have been different without the policies?

I aim to answer this by conducting a counterfactual analysis of the burned area in the 2014 fire event.

## **V. METHODS**

### ***Analytical Model***

To assess the effectiveness and how significant the forest policy is, I compared the level of damage in the 2014 fires (actual) with a counterfactual scenario where the policy had not been enacted. For the *status quo* event, data were collected on the damages and costs of the January-March 2014 fire such as forest and land area burned, fire-fighting cost, loss in transportation, health, and other relevant sectors caused by the fire. The World Bank's earlier study (2014) provided this information. I used the actual hectares of area burned during the fire and the total dollar value of damage and losses to represent the actual level of severity on the early 2014 fire with the policy being enacted. The World Bank's study made

a distinction between ‘damage’ and ‘losses’ based on the assessment methodology they used.<sup>6</sup> According to the assessment guidance, **damage** is considered as “total or partial destruction of physical assets” in the area in which the disaster occurred. This reflects the monetary value needed to estimate reconstruction or replacement needs. **Losses** is considered as “changes in economic flows arising from the disaster”, which among other things involves the decrease of revenues and production, and expenditures for emergency needs. Both damages and losses reflect the economic impact of a disaster.

The counterfactual scenario is developed to be compared to the *status quo* (actual). This was accomplished by conducting interviews with 14 forest fire experts from government officials of ministries or agencies and NGOs relevant to the policy assessment. The interview was designed to understand how the fire would have been different had the policy not been in effect. Interviewees were asked to express how the total hectares of area burned would have been different had the policy not been enacted. From these responses, I extrapolated to obtain the number of *counterfactual* hectares of area burned without the policy. With this number, I estimated the *counterfactual* total dollar value of damage and loss.

With the same units of damage and losses from the *status quo* and the counterfactual scenario, I was able to compare the two, calculate the difference, and estimate how much damage and loss in terms of monetary value was avoided by having the policy in the province. I further analyzed this number relative to several economic measures to get a sense of how effective the policy is.

*Counterfactuals* are “conditional statements” (Nolan, 2011) based on an expected outcome if the factual causes had not materialized. Counterfactual analysis involves asking hypothetical questions of ‘how would A be if C happened (or not happened). For example ‘*if the banks had not been liquidated, the Suharto regime would not have fallen*’. The hypothetical question here is what would have happened to the Suharto regime had the banks not been liquidated in the first place. Therefore, we would be interested in understanding and weighing whether liquidating the banks was the right policy to enact. Although the hypothetical question of what would have happened if the policy was not enacted can be challenging to address, contemplating counterfactuals and posing conditional statements can be helpful when we consider future options, even though a particular event actually happened (Nolan, 2011). In this study, I use interviews with subject experts to develop a counterfactual scenario of how extensive fire damage would have been without policies in place.

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<sup>6</sup> The UN ECLAC (*Economic Commission for Latin America and the Caribbean*) developed a methodology to assess damage and losses called the *DaLA methodology* in calculating the overall economic valuation (“Damage, Loss and Needs Assessment (DaLA) Guidance Notes,” 2010).

### ***Subject Selection for Expert Interviews***

Prior to selecting the interviewees, I identified 14 organizations, government agencies and ministries, as well as NGOs that are working directly, are closely related, and/or have interests in the issue. Due to my previous experience working on forest fire issues in Indonesia through one of the government's ministries, I worked closely with officials from various ministries and people who are responsible for this particular issue. I was able to contact my network and ask their willingness to participate in the study. Therefore, the selected interviewees are those who are competent to talk about the areas in which I am interested.

I interviewed 14 government officials who are fire-related experts, both at the national and provincial level, and fire-experts from several NGOs. All interviewees were based in Indonesia and were Indonesian nationals. All of the experts from the national government who were interviewed were directly involved in acquiring, analyzing, and providing fire-related information on the eight fire-prone provinces in the country, including Riau, for the higher-level decision-maker in their respective institutions. They have worked on fire-related issues in the country for at least 6 years of their career.

All of the experts from the provincial government who were interviewed are directly involved in on-the-ground inspections and/or operations and responsible to convey information to the higher-level decision-maker in their respective agencies. All of the provincial-level government experts who were interviewed have worked on fire-related issues in Riau for at least 7 years. Fire experts from the NGO group were involved in examining and analyzing fire-related issues in Indonesia (either at the Riau level or at the national level) for at least 4 years.

**Table 1. Interviewee typologies**

#### ***State Government***

Ministry of Forestry\*  
Ministry of Environment\*  
National Agency for Disaster Management (*BNPB*)  
National Development Planning Board (*BAPPENAS*)  
National Meteorology, Climatology, and Geophysics Agency (*BMKG*)  
Agency for the Assessment and Application of Technology (*BPPT*)  
National Aeronautics and Space Agency (*LAPAN*)

#### ***Provincial Government***

Riau Disaster Mitigation Agency (*BPBD Riau*)  
Riau Administration's Environment Agency (*BLHD Riau*)  
Riau Natural Resource Conservation Agency (*BKSDA Riau*)  
Meteorology and Geophysics Agency of Riau (*BMG Riau*)

**NGO**

Foundation for Disaster and Risk Mitigation (YPRB)  
World Wildlife Fund (WWF)  
World Resources Institute (WRI)

\*: President Joko Widodo's administration has merged the Ministry of Forestry and the Ministry of Environment into one institution (the Ministry of Environment and Forestry) by the Presidential Regulation signed on 21 January 2015.

I conducted a semi-structured interview using a set of questions based on queries in which I am interested, which would lead to answers to my general research questions. Each interviewee participated in a 30-45 minute interview, where they were asked about forest fire-related issues. Because almost all of the interviewees resided in Indonesia, I used either an international phone call or Skype during the most convenient time for the interviewees.

However, due to the absence or unstable internet connection in some of the interviewee's areas and/or the availability of a Skype account, international phone calls became the preferable means of communication (especially for those located in Riau). However, this eliminated the ability for the interviewees and I to look visually at maps and, therefore, we had to rely on describing and explaining verbally the areas/districts/subdistricts we intended to discuss.

***Research Questions/Hypotheses***

Research questions were designed to explore the counterfactual scenario: *what would have happened if the policies had not been in place*. In addition, its intent was also to be able to explore the policy process on land and forest fires in Riau to be able to understand the broader context of the policy. Therefore, my general research questions were divided into two aspects:

1. How did the policy process evolve in Riau?
2. How would the 2014 forest fires in Riau have been different without the comprehensive plan of action on forest fires?

To answer these questions, my semi-structured interview design was focused on five general areas: pre- and post-policy differences in general, differences in specific elements of the policy, provincial government motivations and commitment, assessment of the counterfactual scenario, and assessment of the policy focus in Riau.

**Table 2. Description of interview questions posed and rationale for asking them**

<p><b>Pre- and post-policy differences (in general)</b></p>	<p><i>Do you think there is a difference in policies on forest fires in Riau before and after the Plan of Action on forest fires was enacted in 2008? In what ways do you think they are different?</i></p> <p>This question was intended to clarify whether there was a moment of recognition for the interviewees that there were differences on how policies were in Riau before and after the PoA took place.</p>
<p><b>Pre- and post-policy differences (specifics on preventive, fire suppression, and early warning systems)</b></p>	<p><i>In what ways do you think preventive efforts, early warning systems, and fire suppression efforts of forest fires in Riau are different before and after 2008?</i></p> <p><i>Would the local people in Riau have had worse or better access to technology needed for monitoring measures without the policy? In what ways?</i></p> <p>These open-ended questions were intended to gain comprehension of how each aspect was being conducted differently in Riau after the policies took place.</p>
<p><b>Provincial government motivations and commitment</b></p>	<p><i>Do you think there are any differences in the approach to which the provincial government handles fires after the policy was established? If yes, to what extent? If no, why do you think so?</i></p> <p>This question is specifically to understand what has changed in the approach of Riau officials after the policy was in place.</p>
<p><b>Assessment on counterfactual</b></p>	<p><i>According to the report, there were about 176,000 hectares area burned in Riau during the January-March 2014 forest fires. How do you think this would have been different without the policy?</i></p> <p><i>How much more (or less) area do you think would have been burned without the Plan of Action of 2008?</i></p> <p><i>(interviewees were given a range of options): no difference, 0-10% higher, 11-25% higher, 26-50% higher, 50-75% higher, more than 75% higher)</i></p> <p><i>Can you show (or tell) me in the firespot map, which areas do you think could have been burned in the 2014 fire in addition to the affected areas had the policy not been in place? Which districts? Which part of it? Why?</i></p>



	<p>This question is an important part of the interview, intended to develop a whole counterfactual scenario of how much worse or better the fire would have been. It allows the interviewer to get a better understanding on how big the areas are that were avoided by the fires due to the policies and in which districts they are located.</p>
<p><b>Assessment on policy focus (de facto and de jure)</b></p>	<p><i>Indonesia's Comprehensive Plan of Action is basically categorized into monitoring and prevention, suppression, early warning, regulation, and transboundary cooperation. Which aspect do you think is the most important to be focused on in the context of Riau Province?</i></p> <p><i>Which aspect do you think is dominating the policy context in Riau Province?</i></p> <p><i>Which aspect do you think is most significant in making changes in the way that forest fires are being treated after 2008 in Riau?</i></p> <p>This question allows the interviewees to reflect on the gaps between policies they believe should have received more attention and policies that are being focused on in reality. This question can allow us to conclude whether there is a 'consensus' and common understanding among fire-experts on what the decision-makers should focus on regarding fires.</p>

### **Data Collection**

Interviews were recorded on a phone recorder and transcribed. I translated the interviews from Indonesian into English, because Bahasa Indonesia is my native language. Furthermore, it is more accurate for me to do the translating, because I was the interviewer and, therefore, had a better understanding of the context of the discussion. Consent was given orally at the beginning of the interview. I anticipated that a response bias may have resulted due to the interviewees' association with the institutions in which they worked; some of them worked in the institutions that played a major role in the development of the action plans. However, in my introduction I explained that their responses and identity would be kept confidential, thus, they were free to express and convey their most objective judgments and honest opinions on the questions posed.

My qualitative data was comprised of transcripts from recorded interviews conducted from December 2014 to January 2015, government documents (laws, regulations, instructions, etc), other literature review, as well as knowledge from my 2-years of working for the Ministry of Foreign Affairs at the Environment and Disaster Management desk under the ASEAN departments. For quantitative data, I collected relevant information on Riau land and forest fires from government and other organization

reports and statistics agencies. My study uses data of damages and losses from the 2014 Riau forest fires from a recent study by the World Bank in its July 2014 Indonesia Economic Quarterly report (World Bank, 2014). Both quantitative and qualitative data were collected concurrently to bring together the strengths of both forms of research to validate results. Both will also be merged during the analysis phase.

### ***Data Analysis***

For the first research question on the evolution of the policy process in Riau, I extracted information from the compiled transcripts of interviews in *NVivo software*. I conducted coding and theme relations based on nodes I drew from the general focus questions. By analyzing each theme from nodes, I was able to get qualitative information to answer how the early 2014 fire in Riau is different from the previous years before the plan of action was established.

For the second research question on the effects of the policy, I developed a counterfactual scenario from the 4<sup>th</sup> general area in Table 3. To be able to do this, the interviewees were to make a judgment about how much additional area in Riau would have burned had the plan of action not taken place in the province. They were given a range of options: no difference, 0-10% higher, 11-25% higher, 26-50% higher, 50-75% higher, or more than 75% higher than the existing level of damages and losses. Further, they were asked to provide the rationale for their answers by showing which areas of the districts were spared from land and forest fires due to the policies that were in place.

I further analyzed the discussion results and crosschecked them with a couple of maps. The first map was the Global Forest Watch Fires using the archives of NASA active fires for Indonesia from February to March 2014, with the option of only high confidence fires<sup>7</sup>. From this map I was able to look at the hotspots distribution in Riau during the event across districts. The second is the Eyes on the Forest map, which is a joint project between WWF, *Walhi Riau*, *Jikalahari*, and WARSI<sup>8</sup>. From this map, I included several layers such as government protected areas, pulpwood concessions, and peat soil distribution to be able to capture where the areas of concern and fires overlapped.

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<sup>7</sup> Global Forest Watch Fires. Accessed in December 18, 2014.  
[http://fires.globalforestwatch.org/#v=map&x=102.51&y=1.17&l=8&lyrs=Overlays\\_Layer%2F3&dirty=true](http://fires.globalforestwatch.org/#v=map&x=102.51&y=1.17&l=8&lyrs=Overlays_Layer%2F3&dirty=true)

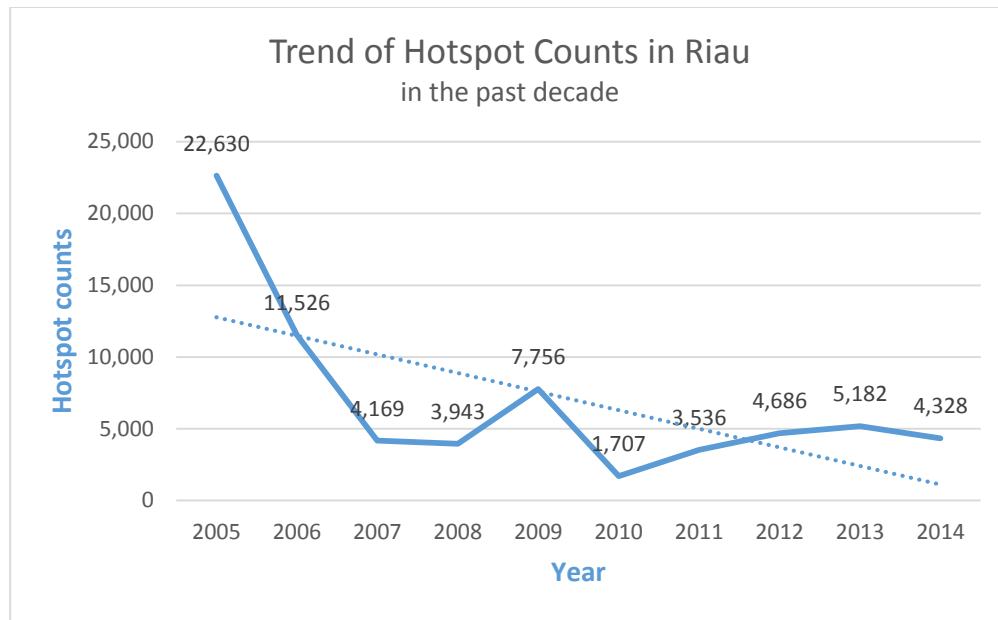
<sup>8</sup> Eyes on the Forests. Accessed in December 22, 2014. <http://maps.eyesontheforest.or.id/>



**Figure 6. Methodology**

## **VI. RESULTS & DISCUSSION**

In spite of the occurrence of fires every year, it is reasonable to conclude from this analysis that much of the hotspots have been reduced over the years due to the policies. Lessons learned from the 1997/1998 fires and a new political regime have created a new set of policies that appear to have contributed to this reduction of hotspots and damages caused by them.



**Figure 7. Trend of hotspot counts in Riau in the past decade.**  
**The 2014 data reflect hotspot counts for the entire year, January to December 2014**  
*Source: Ministry of Forestry database (2014)*

I attempt to investigate the validity of this hypothesis by answering how the 2014 fire in Riau would have been different without the policy. Nevertheless, there are many variables contributing to the severity of land and forest fire occurrences. Among these are the different sources of ignition, weather conditions such as the degree of dryness and other weather anomalies (whether it is an El Niño year or not), and the level of combustible biomass (Herawati & Santoso, 2011). Because each of these variables contributes to fires in Riau, the fires each year are relatively unique, thus, cannot be compared directly to each other. Hence, comparing outcomes between one year and another and attributing it to a policy change would be an incorrect approach. Therefore, it is more appropriate to look at a particular event in a particular year and examine what could have happened differently had no policy been enacted.

### ***Counterfactual – burned areas***

One important aspect of the interview was to extract information on the interviewee's expert judgments of how different the fire would have been without the plan of action. Table 4 summarizes the level of each interviewee's judgment of additional burnt area in percentage if the plan of action was not enacted. It shows the level of how much the policy contributed to the influence of the fire in early 2014, and the resulting level of damages and losses.

Because the responses were significantly varied within the reference ranges that I initially provided, I decided to divide them into two groups: (1) those who responded with relatively high percentages (equal to and higher than 50%) of how much larger fires would have been without the policy, thus exhibiting high optimism on the policies contribution to lower damages and losses (*High*), and (2) those who responded with zero to low percentages (lower than 50%), exhibiting low optimism on the policy's effectiveness (*Low*). For each group, I calculated the mean by averaging the responses to get a single percentage. This resulted in 10% for the *Low* group and 60% for the *High* group. I used these numbers to further calculate the estimation of possible damage and losses 'avoided' in the early 2014 fire, based on the World Bank's estimation of the actual damage and losses<sup>9</sup> (World Bank, 2014).

**Table 3. Summary of counterfactual responses. These numbers represent the percentage of how much the interviewees think more area would have been burnt if the plan of action was not enacted.**

Participants	Institution	Estimated additional burnt area	Group
Interviewee 1	NGO	50%	High
Interviewee 2	State Government	5%	Low
Interviewee 3	State Government	50%	High
Interviewee 4	NGO	10%	Low
Interviewee 5	State Government	25%	Low
Interviewee 6	State Government	10%	Low
Interviewee 7	State Government	75%	High
Interviewee 8	State Government	75%	High
Interviewee 9	Provincial Government	60%	High
Interviewee 10	Provincial Government	70%	High
Interviewee 11	Provincial Government	50%	High
Interviewee 12	Provincial Government	50%	High
Interviewee 13	State Government	10%	Pessimists
Interviewee 14	NGO	0%	Pessimists

<sup>9</sup> The World Bank's (2014) assessment of damage and losses was conducted using the standard Damage and Losses Assessment (DaLA) methodology developed by the UN ECLAC <https://www.qfdr.org/Track-III-TA-Tools>. The assessment analyzed impact on each sector such as productive sectors (agriculture, trade, industry, tourism), social sectors (health and education), and environment.

**DaLA methodology** distinguishes damage and losses in calculating the overall economic valuation ("Damage, Loss and Needs Assessment (DaLA) Guidance Notes," 2010). **Damage** is considered as "total or partial destruction of physical assets" in the area in which disaster happens. This reflects the monetary value needed to estimate reconstruction needs. **Losses** is considered as "changes in economic flows arising from the disaster" which among others involves the decrease of revenues and production, and expenditures for emergency needs. This typically reflects the socio-economic impact of a disaster.

Summary:

High	8 participants	Average:	60%
Low	6 participants	Average:	10%

The interview results suggest on average there could have been 10 - 60 % more area burnt in the early 2014 fires without the policy. More interviewees estimated there could have been more area burnt in 2014 without the policy, ranging from 50 to 75% more hectares, than lower levels of burnt areas. There is one interviewee who argued that there would be no difference. However, there is no clear signal as to which group of interviewees was correct due to the small number of respondents. Therefore, I included the responses of both groups (low and high) as a range.

The World Bank estimated the early 2014 fire caused total damage and losses of about 935 million US dollars, which is 2 % of Riau's GDP in 2013<sup>10</sup>. This is roughly equivalent to 153 US dollars per capita in the province (7,783 US Dollar). As a comparison, Riau's budget for health in 2013 was 0.1 % of its GDP for the same year<sup>11</sup>. This means that the cost of one Riau forest fire event in 2014 could have been used to increase its health budget by almost 20 times.

I multiplied the World Bank damage estimates by the counterfactual percentage range (low and high) to see how much more cost could have incurred without the policy. We can estimate that the government intervention saved at least 21.2 million US dollars (low) in additional damage and losses, up to 455 million US dollars (high). In terms of Riau per capita, this would mean that the policy could save Riau about 3.5 to 75 US dollars per capita from extra damage and losses. Thus, although the fire cost 935 million US dollars, it could have been worse.

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<sup>10</sup> Riau's GDP in 2013 is IDR 522 trillion or about US\$ 47 billion (BPS, 2014).

<sup>11</sup> Riau's health budget in 2013 is IDR 555 billion or about US\$ 50 million (BPS, 2014; Fitra, 2013).

**Table 4. Summary of counterfactual calculations**

	Status quo (Level of damages and losses Feb-March 2014 in Riau with the policy been enacted since 2007)	Counterfactual Level of damages and losses if the policy was not in place
<i>Total area in Riau</i>	8,702,366 ha	8,702,366 ha
<i>Area burnt</i>	176,000* ha	
<i>Counterfactual area burnt</i>		
Low (10% higher than status quo)		176,000 (1.10) = 193,600 ha
High (60% higher than status quo)		176,000 (1.60) = 281,600 ha
<i>Value of damage and losses</i>	935,000,000* US\$	
Damage	7,300,000* US\$	
Losses	862,000,000* US\$	
<i>Estimated savings from policy (Low)</i>		21,230,000 US\$
Damage		7,300,000 (1.10) = 8,030,000 US\$
Losses		862,000,000 (1.10) = 948,200,000 US\$
Total		956,230,000 US\$
<i>Estimated savings from policy (High)</i>		455,880,000 US\$
Damage		7,300,000 (1.60) = 11,680,000 US\$
Losses		862,000,000 (1.60) = 1,379,200,000 US\$
Total		1,390,880,000 US\$

\*: World Bank (2014)

**Table 5. Partial cost for implementation of the plan of action.**

The numbers are compared to the damages and losses from the early 2014 fire from the World Bank's estimates and the counterfactual scenario range.

	(Million Rupiah)	(Thousands US Dollars)	(US Dollars)
<i>Cost of the plan of action from two government institutions in 2014</i>			
BNPB (National Disaster Management Agency)	164,000.00	14,909.00	
Ministry of Forestry			
Forest fires control and management	46,564.00	4,233.00	
Forest fires investigation & security	35,576.00	3,234.00	
<b>Total BNPB &amp; MoF expenditure</b>	246,140.00	22,376.00	
<b>Total benefits</b>			
Low		21,230.00	
High		455,880.00	

Rate for conversion 1 USD = Rp 11,000

Source: BNPB and Ministry of Finance, 2015.

The calculation in **Table 4** is based on two assumptions:

1. There is a linear proportional relationship between burnt area and damage and losses. Implicitly, this means 10 % more burnt areas would have resulted in 10 % more damage and loss from longer fire episodes, longer time to extinguish, longer haze, and disturbed economic activity throughout the province.
2. There is a uniform soil carbon content across different districts. In reality, there are various levels of peat soil depth all over the province ranging from less than 1 meter to more than 3 meters, with different land use conversions (Mubekti, 2011). This would affect the estimates of carbon and carbon release, the amount of haze that resulted from the burning, and the number of cancelled days due to the haze and low visibility which would affect the total loss due to reduced economic activity in the province.

The comparison between the cost to implement the plan of action in 2014 and the counterfactual damage and losses might suggest two things. For the minimum range, the cost to implement the plan of action would most likely outweigh the benefits of saving 3.5 US dollars per capita by a relatively small value (0.19 cents). At the maximum range, the cost information indicates the benefit significantly outweighed the cost by almost 20 times. However, the total cost is only comprised of the budgets from two institutions, the Ministry of Forestry and BNPB. Because they are leading institutions for many measures in the policy list, they have the most substantial budget represented by this policy. However, because the plan of action is comprehensive and involves many government agencies, the rest of the budget and other resources would be distributed among institutions associated with their field. Consequently, the cost of policy implementation is most likely higher than what is being exhibited here (**Table 5**).

Given the wide range of possible savings from implementing the plan of action, it remains unclear how much the benefit exceeds the cost. However, we can conclude that the benefits (monetary value saved from a more severe fire) would most likely offset the cost to prevent a more severe fire. Therefore, there is a reason to believe *some* elements of the policy actually might have had some influence in controlling the severity of fires in early 2014, thus allowing the province to avoid worse damage and losses.

The interviewees came from diverse home institutions with varied types of involvement, proximity, and knowledge of the plan of action. Thus, each of them provided unique information corresponding to their relationship with Riau fires. Of all interviewees, the provincial government and local NGO revealed more detailed information on existing policies in specific districts, even at the



subdistrict level. They were able to make their own assessment about what the landscape and physical condition would have looked like without policy intervention due to their direct contact in the province on a daily basis for years. They were able to visualize specific subdistricts and villages that might have been affected, and often related them to existing policies and the nature of its terrain. In general, the discussions allowed me to better make a compilation of areas that might have suffered from additional area burns.

Although the interviews were designed to extract expert judgments of how different the fire would have looked like, counterfactual analysis is rather independent from whether its result is true or false (Ballart & Riba, 2000). The fact that these experts were able to argue and try to depict areas that could have been affected gives us a ray of light as to what extent government intervention might have influenced a particular district or subdistrict. Furthermore, it also gives an indication of which districts the policy might have had a more effective impact and by which exact element of the policy. Therefore, regardless of the correctness of a counterfactual scenario, the analysis would still be valuable because it is mind-expanding, drives debate, helps mitigate bias, and helps to make decisions in the future (Nolan, 2011).

### ***Relevant Information on the Policy Process***

Besides exploring the counterfactual scenario on the 2014 fire event in Riau, interviews with forest fire experts have also given me a better understanding about how significant the policy is and what kind of significance it portrays compared to the regime without any relevant policy enactment. From the interviews, the experts were able to reveal a number of interesting themes and ideas about the policy implementation, particular weaknesses and strengths, and the experts' assessment on specific elements of the plan of action.

The experts in general have a common understanding that the government has produced a 'full-package' policy, engaging all related ministries and provincial authorities. The impact is crucial in synergizing and integrating featured programs from each institution and concentrate them on fire-prone areas. However, they agree that having the plan of action on paper alone is not sufficient, and that other relevant aspects are also crucial to the success of solving the issue. The first is a strong commitment from all related institutions. The second is an oversight unit to ensure that the policies are being implemented and enforced.

Several interviewees think that most changes are forced and initiated by the national government, which is probably driven by international pressure and NGOs. Thus, because it is motivated externally and

rather enforced from the national government, it would be challenging to get Riau's full commitment to resolve the problem. As an interviewee from the Riau province mentioned, *"The plan of action was a starting point for the Riau government to sign commitments at the provincial level to tackle and deal with forest fires more seriously. Otherwise I am less optimistic that the provincial government would do anything significant"* (Interviewee 8).

However, the policy is still a good stepping stone to a shifting regime of fire policy, because before early 2000 studies have mentioned the policies related to this were either very limited, minimal, or non-existent. The momentum after 1997-1998 was a sobering wake-up call for the authorities, although it took several years to produce something concrete. From the provincial policies, at least, this is reflected in its intermediate provincial development plans (*Rencana Pembangunan Jangka Menengah Daerah / RPJMD*) 2009-2013 on environment development. One of the aspects is the emphasis on sustainable peatland management by promoting non-burning methods for land clearing. Furthermore, it sets off agreements (memorandum of understanding) for sustainable peatland management between the Ministry of Environment and the Governor of Riau, the regents of Siak, Pelalawan, Bengkalis, Indragiri Hilir, Rokan Hilir, and the mayor of Dumai – all the heads of areas that are well-known to be fire-prone.

### ***Two areas of improvement resulting from the policy***

The interviewees, especially those from the government, revealed at least two elements on how significant the plan of action is in changing the attitude and culture of decisions related to pre- and post-fire events in Riau:

#### ***1. Improved capacity and access of technology and data.***

The plan of action is said to be effective in transferring knowledge and capacity from the national government to Riau in terms of monitoring capacity and technology. Earlier hotspots information had limited access among officials, but now they can be accessed publicly and help expedite decision-making. The Riau government is now also able to access and monitor hotspots from the national mailing list (*SiPongi*) and analyze hotspots coordinate's data that are received from satellite images to detect locations of the hotspots origins. They can now easily retrieve information related to weather from the national agencies' websites. *"The most distinct thing after the plan of action is implemented in Riau is how there has been increased awareness from all government officials in taking advantage from data and science-related information. It is more inclusively distributed, and so responses were relatively faster."* (Interviewee 13).

The Fire Danger Rating System (FDRS), which was initially only possessed by a couple of national agencies, also can be utilized inclusively. *“I do not think there are any bombastic breakthroughs on early warning system – we’ve had the FDRS for a while, but the way this information is disseminated and distributed down to the local level has really helped. National ministries are now reaching out and communicating better with the provincial government in fire-prone areas” (Interviewee 5).*

2. *Improved emergency response (fire suppression).*

Prior to the enactment of the plan of action, responses towards potentially massive fire events were sporadic and uncoordinated. A number of interviewees expressed how there was no single command and each institution tried to outdo others. With the plan of action in place, efforts to deal with forest fires were more coordinated and systematic. Responses were also adjusted to the level of alert status of the disaster<sup>12</sup>.

In the era before 2007-2008, fire suppression efforts had not been carried out comprehensively, because there had been many limitations on the institutions responsible. Now, fire suppression efforts and emergency response were held more comprehensively and involve all different agencies. This is due to a more defined mandate and clear national law to support such activity. *“There’s also a sense of pride, you know, that now we are able to do all suppression efforts by ourselves – we utilize all national capacities without any national assistance. All the water bombing, weather modification efforts, cloud seeding... and supported by Manggala Agni (fire brigade)... all are by our very own people, budget, and leadership” (Interviewee 7).*

***Areas for improvement***

The experts realized that the policy, however, still needed improvement. I was able to extract information on a number of weaknesses mentioned by the experts about the plan of action or areas that could use improvement.

1. *The lack of specific policy details.*

The package plan attempts to include every aspect related to land and forest fires, but ends up being too broad, hence missing small practical details. Therefore, the province has little reference for

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<sup>12</sup> Whenever the alert level is “disaster alert” (*siaga darurat*), the commandant in charge is from the provincial government – (usually the regional secretary or Sekretaris Daerah) or the Head of Riau Disaster Mitigation Agency (BPBD). But whenever the status goes up to “disaster emergency response” (*tanggap darurat bencana*), then the commandant in charge is the Head of the National Agency for Disaster Management (BNPB) by mobilizing and utilizing all of the national resources available.

criteria to execute certain actions. For example, there is no exact threshold or clear criteria to announce certain levels when the fire gets out of control. *“There’s no clear reference... How to proceed in certain kinds of magnitude of hotspots for instance? What kind of situation determines the kind of task force the government should be sending? When the satellite imagery shows 10 hotspots and 100 hotspots, do we execute similar actions? Those are questions that should be answered...” (Interviewee 2).*

2. *Different tools or system used among government institutions.*

Different agencies also use different systems or tools for monitoring. For instance, the Ministry of Forestry uses NOAA-18 satellite program and the BMKG uses MODIS Aqua/Terra satellites. According to the experts, the two satellites can result in significantly different images, because they have different threshold levels for determining fire occurrence. MODIS is thought to be more reliable and has varied indicators to support its confidence level of fire occurrence. Although, none of the interviewees really had an idea why NOAA-18 satellite is still being used by the Ministry of Forestry. The use of these different systems, therefore, resulted in different hotspot counts and different references when making actions, which can be confusing for the provincial government.

3. The policy does not include incentives for a zero burning policy.

The policy is said to be lacking economic incentives for a zero burning policy. As long as there is still an advantage from the efficiency of using fire, people will not be motivated to stop using burning for land clearing.

***Caveats of the analysis***

During my attempt to gather detailed information about the plan of action, I became aware of the limited availability of this information to the public. Besides not being fully well-documented, there is yet to be a single government institution to comprehensively disclose it through its official website or other forms of government reports. I obtained most information about the plan of action through interviews with government officials, my professional experience being engaged at ASEAN meetings, and documents related to the meetings. Due to the nature of these documents and confidentiality issues, however, they cannot be used as identifiable references in this report. Furthermore, the policy is described better through reports made by ASEAN and some neighboring countries (Singapore and Malaysia) due to their involvement in a number of projects under the plan of action. This issue became more obvious during the interviews where government officials were more familiar with the plan of action and, thus, were able to provide detailed judgments about it. The same situation did not apply to most

NGO interviewees, although they are aware of a number of the programs and projects under the plan of action.

This condition reveals a possible flaw of the policy. The policy's lack of disclosure and the public's limited knowledge make it challenging to be assessed and evaluated by different stakeholders. This limits the ability for the policy to receive further input for improvement and limited opportunities for cooperation with non-government parties. A comprehensive and well-documented policy would enable external parties to help identify what other areas they can engage with to complement existing programs or projects. Because forest fire is a big issue that needs all the resources it can get, the government would benefit from cooperation and involvement with all parties. Furthermore, a poorly documented and vague policy is bad publicity for the government and sends a false message to the public that the government is not doing anything meaningful. Because they are criticized constantly for annual forest fires, one good strategy would be to reveal efforts on which they have been working.

In addition, the set of interviews I conducted indicates that fire suppression measures and monitoring efforts might have had greater significance in influencing the level of damage and losses in the early 2014 fire, because they were highlighted more than other elements of the policy. The experts came from different institutional backgrounds and could have highlighted other elements of the policy which relates more to their work. Given the fact that most of them emphasize on only fire suppression and monitoring efforts suggested that these elements seem to be really efficient to the experts. However, a number of experts pointed out how focusing on fire suppression and devoting substantial budget for it is not a good investment and would not bring significant long term impacts. They expressed how the government should have put more focus on preventive efforts, for then they could have saved much of the suppression budget and resources if there had been no fires to begin with.

## **VII. CONCLUSION**

The previous analysis led me to several conclusions. First, based on the interviews I conducted with 14 forest fire experts (7 state officials, 4 provincial officials, and 3 NGOs), on average, they were convinced that had the policy not been enacted, the 2014 forest fire would have burnt 10 - 60 % more area and increased the overall damage and losses. There is one interviewee who argued that with or without the policy nothing would have changed. This reveals, although the policy is yet to prevent 100 % of the massive fire occurrences in the country, experts from my set of interviews were somewhat optimistic that the policy did limit the level of damage and losses. Moreover, most of them gave particular emphasis to the success of the fire suppression element of the plan of action. This might suggest that

other elements of the policy either could be improved to ensure hotspots reduction, or be reevaluated to determine if they were actually a significant element of the policy.

Second, based on the percentage range of counterfactual area burnt, the benefits (monetary value saved from a more severe fire) most likely outweighed the cost of implementing the policy action. The total expenditure from the leading institutions was about 22 million US dollars, which was about half of Riau's health budget in 2013. On the other hand, the potential benefit ranged from 21.2 (low) to 455 (high) million US dollars. In the high scenario, the benefit of having the policy in 2014 outweighed the cost by about 20 times, which is 9 times Riau's health budget in 2013. This corroborates the reason to believe that *some* elements of the policy might have had some influence in controlling the severity of fires in early 2014. If the government continues to perfect its policy measures, the cost of implementing the policy might no longer be relevant compared to the benefits Riau obtains from having the policy in place.

Third, based on the interviews and my literature review, the plan of action, which was enacted about eight years ago, still has its shortcomings and needs regular evaluation. This is necessary to ensure that each of the programs under the policy package is well-defined in terms of its goals, clear in what and how to achieve it, and supported by detailed instructions for provincial actions. Otherwise, the policy will only be a vague directive and will leave the provincial government confused and misled.

## **VIII. POLICY RECOMMENDATIONS**

Based on the above conclusions, there are several policy recommendations related that might help resolve some of its weaknesses. *First*, for the magnitude and impact of this kind of large fire, a budget of 22 million US dollars for the policy is minuscule. The policy expenditure is 2.3 % of the total damage and losses, which gives us a sobering fact of how little the government spends compared to the consequences suffered by the people of Riau. The policy cost is also only 0.05 % of Riau's regional GDP. This means that even if Riau decided to spend that much, it is a small number; such an expenditure would be reasonable, given that it is a rich province that relies significantly on the extraction of natural resources. With additional budget support for the policy measures, more can be done to increase the likelihood that Riau can avoid more severe fire damage and losses.

*Second*, because weather anomalies and other climate parameters play a significant role in aggravating fires in the province, there are two approaches for land clearing management in the province. The first is that the government should invest in zero-burning practices by subsidizing machinery for land clearing to small farmers and small-medium companies. Therefore, Riau could decrease its ignition risk from deliberate burning. The second is to use a 'prescribed burning' policy. This way, the government has

to specifically regulate farmers and plantations about when and where to burn to lower the risk of fires spreading and escalating beyond the targeted area. This means that prescribed burning can only be allowed under a specified and predetermined wind speed and direction, relative humidity, air temperature, atmosphere stability, precipitation, and other weather parameters to avoid fires from getting out of control. The government can completely ban fire when an El Niño event is predicted to hit the country.

*Third*, the policy package is comprehensive enough, but ensuring that it is really translated into sound implementation is a challenge, because all of the agencies are more or less related horizontally in the bureaucracy. Therefore, the policy should be complemented with a special agency or unit that has the jurisdiction and authority to oversee the entire execution of the policy, and which has a higher administrative rank relative to other ministries with the authority to issue forms of punishment or reward.

*Forth*, the information about the plan of action would be best if it is made in a more transparent way and made publicly available. Simply by making the plan accessible through websites or government reports would educate the public better on what efforts are being sought and how the public can support these means. It should also stimulate ideas among external parties who would be willing to contribute to reducing the risk of large fire events in Riau and better assess future efforts that are needed. Because land and forest fire issues are major environmental problems in the country, the government would most likely benefit from all the help they can get to solve this issue.\*\*\*

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**Appendix 1.** Ministries, agencies and officials responsible for improving land and forest fires control in the Presidential Instruction Number 16/2011

1. The Coordinating Ministry for People's Welfare	<i>Kemenko Kesra</i>
2. The Ministry of Forestry	<i>Kementerian Kehutanan</i>
3. The Ministry of Environment	<i>Kementerian Lingkungan Hidup</i>
4. The Ministry of Agriculture	<i>Kementerian Pertanian</i>
5. National Disaster Management Agency	<i>BNPB</i>
6. The Agency for Meteorology, Climatology and Geophysics	<i>BMKG</i>
7. The Agency for Aerospace	<i>LAPAN</i>
8. The National Development Planning Agency	<i>BAPPENAS</i>
9. Chief Police	<i>Polri</i>
10. National Commander of Armed Forces	<i>TNI</i>
11. The Ministry of Research and Technology	<i>BPPT</i>
12. The Ministry of Home Affairs	<i>Kementerian Dalam Negeri</i>
13. The Ministry of Foreign Affairs	<i>Kementerian Luar Negeri</i>
14. Attorney General	<i>Jaksa Agung</i>
15. Governors and Mayors	<i>Gubernur dan Bupati</i>